University of Rwanda
College of Science and Technology
School of Applied Sciences
Electrical and Telecommunication: Year 2 Semester 2

MAT 3221 Engineering Mathematics 4–Set 1

1. Here are three different $g(x)$ functions. All are rearrangements of the same $f(x)$. What is $f(x)$?

   (a) $(4 + 2x^3)/(x^2) - 2x$.
   (b) $\sqrt{(4/x)}$.
   (c) $(16 + x^3)/(5x^2)$.
   (d) Which of these converge? What x–value is obtained? Are there starting values for which one or more diverge? Which diverge?

2. Solve this system with Jacobi method. First rearrange to make it diagonally dominant if possible. Use $[0, 0, 0]$ as the starting vector. How many iterations to get the solution accurate to five significant digit?

$$\begin{pmatrix} 7 & -3 & 4 & 6 \\ -3 & 2 & 6 & 2 \\ 2 & 5 & 3 & -5 \end{pmatrix}$$

3. The following ordinary difference table is for $f(x) = x + \sin(x)/3$. Use it to find

   (a) $f'(0.72)$ from a cubic polynomial.
   (b) $f'(1.33)$ from a quadratic.
   (c) $f'(0.50)$ from a fourth–degree polynomial.

   In each part, choose the best starting i–value.

i	x_i	f_i	Δf_i	$\Delta^2 f_i$	$\Delta^3 f_i$	$\Delta^4 f_i$
0	0.30	0.3985	0.2613	-0.0064	-0.0022	0.0003
1	0.50	0.6598	0.2549	-0.0086	-0.0018	0.0004
2	0.70	0.9147	0.2464	-0.0104	-0.0014	0.0005
3	0.90	1.1611	0.2360	-0.0118	-0.0010	
4	1.10	1.3971	0.2241	-0.0128		
5	1.30	1.6212	0.2113			
6	1.50	1.8325				

4. Use the data in the table to find the integral between $x = 1.0$ and 1.8, using the trapezoidal rule:

   (a) With $h = 0.1$.

(b) With $h = 0.2$.

(c) With $h = 0.4$.

x	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8
$f(x)$	1.543	1.669	1.811	1.971	2.151	2.352	2.577	2.828	3.107

5. Employ inverse interpolation to determine the value of x that corresponds to $f(x) = 0.93$ for the following tabulated data:

x	0	1	2	3	4	5
$f(x)$	0	0.5	0.8	0.9	0.941176	0.961538

Note that the values in the table were generated with the function $f(x) = x^2/(1 + x^2)$.

(a) Determine the correct value analytically.

(b) Use quadratic interpolation and the quadratic formula to determine the value analytically.

(c) Use the cubic interpolation and Lagrange interpolation to determine the value analytically.